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Winter Nesting Habits of Northern Flying Squirrels in Sub-Boreal Spruce Forests

This note summarizes two years of research investigating the characteristics of nest trees used by northern flying squirrels, the type of sites where nesting occurred, and the number and spacing of nest trees used by individual animals. Activity patterns in relation to weather conditions and photo-period were also studied, but are reported elsewhere (Cotton 1999).

FIGURE 1. Northern Flying Squirrel

The northern flying squirrel (*Glaucomys sabrinus*) is an arboreal species found in temperate coastal forests to cold northern boreal forests of North America (Wells-Gosling and Heaney, 1984). Flying squirrels are active year-round, and primary foods include mushrooms, especially fruiting bodies of ectomycorrhizal fungi (e.g., *Rhizopogon* spp.), arboreal lichens (e.g., *Bryoria* spp.), as well as seeds and insects. Flying squirrels in turn are important to birds of prey and mammalian predators such as marten and fisher. Flying squirrels and other small mammals play a significant role in dispersal of mycorrhizal fungi and lichens (Fogel and Trappe 1978; Laurence and Reynolds 1984; Maser et al. 1986; Lesica et al. 1991; Zabel and Waters 1997). Mycorrhizal fungi are in turn important to forest productivity.

Study area

The study was conducted in the SBSmc2 biogeoclimatic variant of west central B.C., primarily at the Smithers Community Forest 10 km west of Smithers. A second site, located near Houston, B.C, was also used in the first year of the study. Dominant tree species at both sites included hybrid white

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spruce (*Picea engelmannii x glauca*), subalpine fir (*Abies lasiocarpa*), lodgepole pine (*Pinus contorta*), and some trembling aspen (*Populus tremuloides*) and cottonwood (*Populus balsamifera* ssp. *trichocarpa*). The Community Forest study site burned in the 1930's and 1940's, and parts of it were selectively logged in the 1950's and 1960's. The result is pockets of old-growth forest and veteran trees scattered throughout younger forests. The Houston site is mostly 140-year-old forest surrounded by extensive clearcuts of the past 20 years.

Characteristics of Nesting Habitat

We monitored 19 radio-collared squirrels during 2 years of study, locating 82 nest trees. Visible witches' brooms and drays (nests constructed of twigs and/or leaves) comprised 18% of the nests. The remainder did not have visible nest structures, thus were likely tree cavities or possibly brooms or drays obscured by the canopy. Nest trees were mostly hybrid spruce or lodgepole pine, and ranged from 16.7–79.0 cm diameter at breast height (dbh), 42–174 years of age, and 11.2–32.7 m tall. The majority were between 25 and 35 cm dbh, 60 and 80 years of age, and 20 to 25 m tall (Figure 1). Although flying squirrels in our study did use some small trees, they tended to select the largest trees available to them. Three-quarters of the animals used at least one nest tree with dbh >43 cm and more than two-thirds used

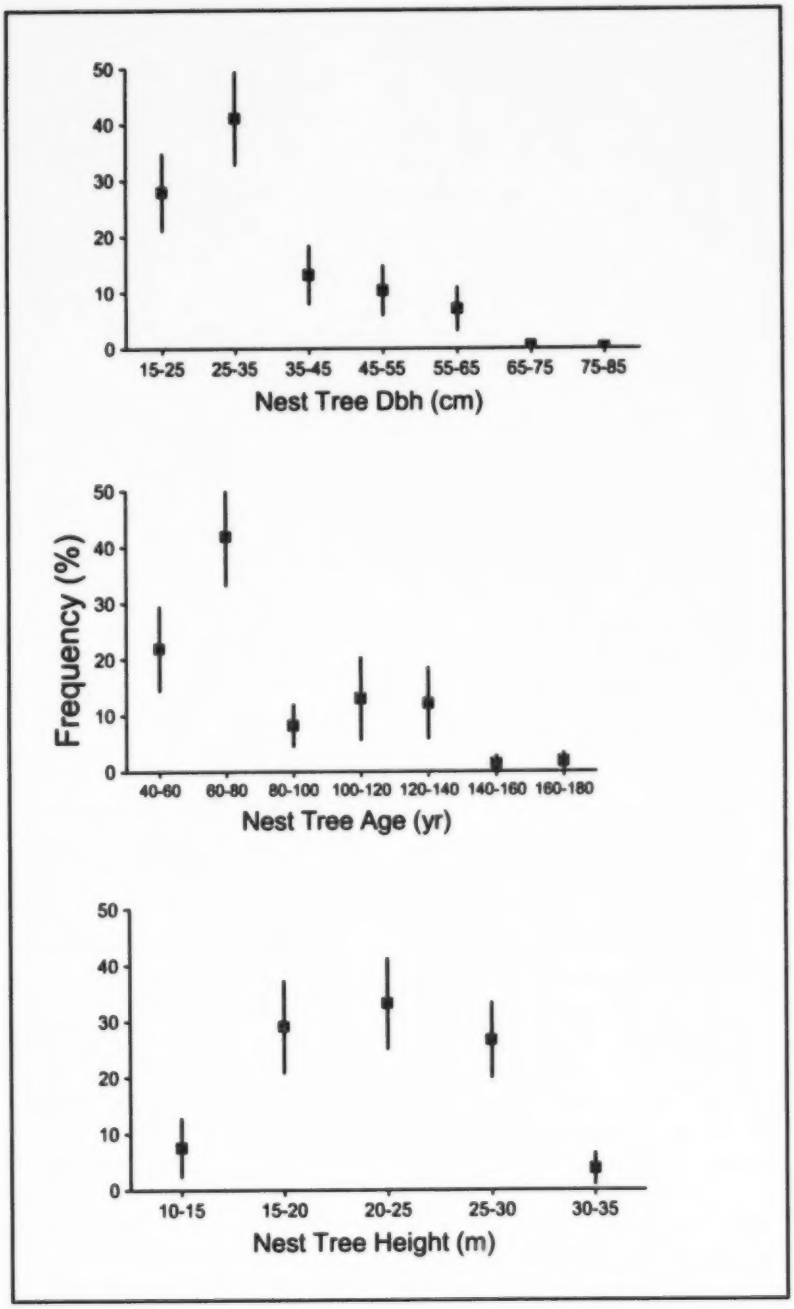

FIGURE 2. Relative frequency (averaged across animals; $\bar{X} \pm SE$) of 82 nest trees used by 15 northern flying squirrels by class of tree characteristics.

at least one tree older than 100 years.

Similar results were obtained in a pilot study (Mahon and Steventon 1993) conducted at the Houston site in the 1992-93 winter. Average dbh of nest trees (n = 15) was 33.7 ± 3.4 cm (± *SE*), and witches' brooms were the most commonly used nest structure.

Using classifications of wildlife tree and wildlife tree habitat value (Ministry of Forests 1998; Guy and Manning 1994; Armleder et al. 1992), most nest trees were relatively healthy with moderate lichen abundance and medium habitat value. Most nest trees were smaller than those ranked highest by the rating system for wildlife tree habitat value; such very large trees (>50 cm dbh) were present but not common in the study area. The wildlife habitat value classification is also higher for snags with moderate decay, although 96% of nest trees used by flying squirrels were in live trees with few or no indicators of decay. Hence, the classification systems may not be effective for determining potential nest sites for northern flying squirrels in this area. The predominant use of live trees rather than snags may reflect the relatively young age of the stands in our study area. Flying squirrels probably select for suitable nest structures rather than tree size or age as such.

Individual flying squirrels used from 3 to 10 nest trees, and the size of core nest areas (area of a minimum sized polygon delineated by nest trees) ranged from 0.03–8.6 ha. Sizes of core nest areas reported by Mahon and Steventon (1993) were also variable, ranging from 2.1 to 14.5 ha (n = 5). Home ranges of the animals are likely larger, including areas that are used for foraging outside core nest areas.
Nests were located predominantly in mesic and moist sites, although several were located on the edges of forested wetlands (Table 1). Most squirrels (61%) used more than 1 type of ecosystem (biogeoclimatic ecosystem classification, Banner et al. 1993), and all but one animal had nest trees located in more than 1 polygon type indicated on the ecosystem map for the Smithers site (MacKenzie and Banner 1991). Ecosystem types determined from ecosystem maps of the Community Forest did not always match on-site determinations at nest sites, but were a close approximation (Table 1). Animals occupied nest sites in a range of seral stages, including pole/sapling and young/mature stands with veterans. Veteran trees in the study area probably augment the availability of suitable nest sites for secondary cavity nesters such as flying squirrels.

TABLE 1. Comparisons of 1) ecosystem types around nest trees used by northern flying squirrels and their associated random samples and 2) classifications determined for nest trees on-site and from ecosystem maps (MacKenzie and Banner 1991) at the Smithers site.

	Occurrence of ecosystem type (%)				
	Dry	Mesic	Mesic-Wet	Wet	Forested Wetland
All nest trees (n = 82)	11.0	39.0	30.5	18.3	1.2
Random locations (n = 246)	10.8	39.2	38.0	11.2	0.8
Smithers: on-site (n = 52)	1.9	42.3	25.0	28.8	1.9
Ecosystem maps (n = 52)	5.8	40.4	38.5	11.5	3.8

Management implications

Even-aged management on commercial rotations tends to reduce structural features such as large diameter trees, snags, live cavity trees, and witches' brooms necessary for many wildlife species. Patch retention harvesting (typically retaining 5–20% of the forested area of a cut-block) could improve habitat for such species by maintaining structural diversity within stands (Coates and Steventon 1995; Hunter 1995). Leaving large old trees, both live and dead, provides potential nesting structures as the surrounding stand re-grows; coarse woody debris left on the ground provides a substrate for forage production, including mushrooms. The Smithers Community Forest had similar patches of remnant trees left after

fire disturbance earlier in the century.

In designating patches of trees to be left after harvesting, particular attention should be given to retaining nesting structures such as large snags, large live trees with cavities, and trees with witches' brooms. Attention should also be given to the location of leave patches. Not all squirrels used riparian zones, thus leave patches should include both riparian and upland locations.

Post-harvest retention patches may not be large enough to be used by flying squirrels until the surrounding second-growth stand has reached a suitable age for travel and foraging. Flying squirrels are highly arboreal and are not likely to cross large openings that would require travel on the ground (Mowrey and Zasada 1984). Sufficient mature forest, however, must remain in the landscape to sustain a squirrel population and provide for dispersal. Partial cutting, such as selection systems and patch removal, may be useful in landscapes that are highly fragmented from previous timber harvesting.

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